

## OVERVIEW:

Formal arguments to properties and sequences are currently defined for some but not all possible types. The objective of this proposal is to expand the list of types so that everything that is allowed to be passed as an argument can be passed as a typed argument.

The standard currently defines only operand types (per 17.4.1). Arguments that are not covered by the current type definitions include “property”, “sequence”, “events”, and “anytype”. The “anytype” is introduced to allow arguments that do not have any data type restrictions to be mixed freely with those that do.

New Types are proposed as follows:

- sequence: sequence instances are passed as type sequence
- property: property instances are passed as type property
- event: this is used for passing arguments (4.8) that are used for clocking purposes
- anytype: used when there are no data type restrictions, meaning that any type is acceptable. The implicit type (that of the declaration of the argument) is used for any semantic checks. This is equivalent to listing the argument prior to any typed arguments.

Examples have been improved.

The following describes the detailed changes that will be required in the standard. All changes are RELATIVE to the revisions of Mantis 928. Also, #1532: “Remove @sequence\_instance from event\_control to take care of sequences with arguments” is assumed.

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## REPLACE

### A.2.10 Assertion declarations

```
property_actual_arg ::=
    sequence_actual_arg
    | property_instance
```

```
property_formal_type ::=
    data_type_or_implicit
```

```
sequence_formal_type ::=
    data_type_or_implicit
```

```
sequence_actual_arg ::=
    event_expression
```

```
event_expression ::=
```

```
[ edge_identifier ] expression [ iff expression ]
| sequence_instance [ iff expression ]
| event_expression or event_expression
| event_expression , event_expression
| ( event_expression )
```

WITH

### A.2.10 Assertion declarations

```
property_actual_arg ::=
    sequence_actual_arg
    | property_instance
```

```
property_formal_type ::=
    data_type_or_implicit
    sequence_formal_type
    | property
```

```
sequence_formal_type ::=
    data_type_or_implicit
    | sequence
    | event
    | anytype
```

```
sequence_actual_arg ::=
    event_expression
```

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```
event_expression ::=
    [ edge_identifier ] expression [ iff expression ]
    | sequence_instance [ iff expression ]
    | event_expression or event_expression
    | event_expression , event_expression
    | ( event_expression )
```

REPLACE

### 17.6.1 Typed formal arguments in sequence declarations

Formal arguments of sequences can optionally be typed. To declare a type for a formal argument of a sequence, it is required to prefix the argument with a type. A formal argument that is not prefixed by a type shall be untyped. A type name can refer to a comma separated list of arguments. Untyped arguments must therefore be listed before any typed arguments.

Exporting values of local variables through typed formal arguments is not supported.

The supported data types for sequence formal arguments are the types that are allowed for operands in assertion expressions (see 17.4.1). The assignment rules for assigning actual argument expressions to formal arguments, at the time of sequence instantiation, are the same as the general rules for doing assignment of a typed variable with a typed expression (see Clause 4).

For example, two equivalent ways of passing arguments are shown below. The first has untyped arguments, and the second has typed arguments:

```
sequence rule6_with_no_type(x, y);  
##1 x ##[2:10] y;  
endsequence  
  
sequence rule6_with_type(bit x, bit y);  
##1 x ##[2:10] y;  
endsequence
```

Another example, in which a local variable is used to sample a formal argument, shows how to get the effect of “pass by value”. Pass by value is not currently supported as a mode of argument passing.

```
sequence foo(bit a, bit b);  
bit loc_a;  
(1'b1, loc_a = a) ##0  
(t == loc_a) [*0:$] ##1 b;  
endsequence
```

WITH

### 17.6.1 Typed formal arguments in sequence declarations

Formal arguments of sequences can optionally be typed. To declare a type for a formal argument of a sequence, it is required to prefix the argument with a type. A formal argument that is not prefixed by a type will be untyped. **When a type is specified, that type is enforced by semantic checks.** A type name can refer to a comma separated list of arguments. ~~Untyped arguments must therefore be listed before any typed arguments.~~

Exporting values of local variables through typed formal arguments is not supported.

The supported data types for sequence formal arguments are the types that are allowed for operands in assertion expressions (see 17.4.1). Sequence instances may be typed using the *sequence* type. *anytype* is used to specify that the argument can have any type that is legal for a sequence actual argument. There are two ways to achieve implicit typing of arguments. The first is to write the implicitly type arguments first in the list prior to specifying any type. The second is to use the *anytype* type.

The assignment rules for assigning actual argument expressions to formal arguments, at the time of sequence instantiation, are the same as the general rules for doing assignment of a typed variable with a typed expression (see Clause 4).

For example, ~~two~~ three equivalent ways of passing arguments are shown below. The first has untyped arguments, and the second and third have ~~has~~ equivalent typed arguments. The first example does not specify any types, so the types of the actual arguments instantiated are used for semantic checks. Similarly, in the second example, “w” has no specified type so the type of the actual argument instantiated is used for semantic checks. Arguments “x” and “y” will be truncated to type bit, and argument “z” will be truncated or extended as necessary to make it of type **byte**.

```
sequence rule6_with_no_type(x, y);
##1 x ##[2:10] y;
endsequence
```

```
sequence rule6_with_type(bit x, bit y);
##1 x ##[2:10] y;
endsequence
```

```
sequence rule6_with_no_type(w, x, y, z);
w ##1 x ##[2:10] y ##1 z == 8'hFF;
endsequence
```

```
sequence rule6_with_type_1(w, bit x, y, byte z);
w ##1 x ##[2:10] y ##1 z == 8'hFF;
endsequence
```

```
sequence rule6_with_type_2(bit x, y, anytype w, byte z);
w ##1 x ##[2:10] y ##1 z == 8'hFF;
endsequence
```

Any integer type can be used to pass delay and repetition values. For example, two equivalent ways of passing delay and repetition arguments are shown below:

```
sequence delay_arg_example ( shortint delay1, delay2, min, max);
x ##delay1 y[*min:max] ##delay2 z;
endsequence
```

```
`define my_delay=2;
cover property ( delay_arg_example ( `my_delay, `my_delay-1, 3, $) );
```

which is equivalent to:

```
cover property ( x ##2 y[*3:$] ##1 z);
```

Parentheses are implicit for passing complex expressions as arguments. Actual arguments that consist of complex expressions are checked at compile time for compatibility with the types of the corresponding formal arguments.

When an argument type is **event**, semantic checks ensure that the argument is a legal event control and that it is only be used for clocking purposes. Any legal event\_control argument is allowed, though the @ sign is not passed, meaning an argument of type event may be any of

hierarchical\_event\_identifier, (event\_expression), \*, or (\*). The following shows an example of passing events:

```
sequence event_arg_example ( event clock )
  @(clock) x ##1 y;
endsequence

cover property ( event_arg_example(posedge clk) );
```

is equivalent to:

```
cover property ( @(posedge clk) x ##1 y);
```

Another example, in which a local variable is used to sample a formal argument, shows how to get the effect of “pass by value”. Pass by value is not currently supported as a mode of argument passing.

```
sequence foo( bit a, bit b );
  bit loc_a;
  (1'b1, loc_a = a) ##0
  (t == loc_a) [*0:$] ##1 b;
endsequence
```

REPLACE

### 17.11.1 Typed formal arguments in property declarations

Formal arguments of properties can optionally be typed. To declare a type for a formal argument of a property, it is required to prefix the argument with a type. A formal argument that is not prefixed by a type shall be untyped. A type name can refer to a comma separated list of arguments. Untyped arguments must therefore be listed before any typed arguments.

The supported data types for property formal arguments are the types that are allowed for operands in assertion expressions (see 17.4.1). The assignment rules for assigning actual arguments to formal arguments, at the time of property instantiation, are the same as the general rules for doing assignment of a typed variable with another typed expression (see Clause 4).

For example, below are two equivalent ways of passing arguments. The first has untyped arguments, and the second has typed arguments:

```
property rule6_with_no_type(x, y);
  ##1 x |-> ##[2:10] y;
endproperty

property rule6_with_type(bit x, bit y);
  ##1 x |-> ##[2:10] y;
endproperty
```

WITH

### 17.11.1 Typed formal arguments in property declarations

Formal arguments of properties can optionally be typed. To declare a type for a formal argument of a property, it is required to prefix the argument with a type. A formal argument that is not prefixed by a type shall be untyped. A type name can refer to a comma separated list of arguments.—~~Untyped arguments must therefore be listed before any typed arguments.~~

The supported data types for property formal arguments include all the types that are allowed for sequences plus the addition of the *property* type. Specifically, all types that are allowed as operands in assertion expressions (see 17.4.1) are allowed as formal arguments. Sequence instances may be typed using the *sequence* type. Property instances may be typed using the *property* type. *anytype* is used to specify that the argument can have any type that is legal for a property actual argument. There are two ways to achieve implicit typing of arguments. The first is to write the implicitly type arguments first in the list prior to specifying any type. The second is to use the *anytype* type.

The assignment rules for assigning actual arguments to formal arguments, at the time of property instantiation, are the same as the general rules for doing assignment of a typed variable with another typed expression (see Clause 4)

For examples of using formal arguments, refer to section 17.6.1.

~~For example, below are two equivalent ways of passing arguments. The first has untyped arguments, and the second has typed arguments:~~

```
property rule6_with_no_type(x, y):  
##1 x |> ##[2:10] y;  
endproperty
```

```
property rule6_with_type(bit x, bit y):  
##1 x |> ##[2:10] y;  
endproperty
```